So, what's it really like to work in biotech?

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ABSTRACT **This essay provides insight into the daily life of a scientist in biotechnology, drawing on experience gained from working in companies ranging in size from four to more than 80,000 employees. The basic scientific training in molecular biology required for the work is similar between academia and industry, but the way in which these skills are applied differs. Biologists in industry settings work as part of large, multidisciplinary teams. This requires relinquishing the degree of intellectual freedom allowed in academia but offers an increased opportunity to see the fruits of one's labor translate into products with the potential to positively impact human or environmental health.**

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INTRODUCTION

Because I work in biotechnology, I was asked to provide some perspective on careers within the biotechnology industry for graduate students and postdoctoral fellows. After completing a typical PhD and postdoctoral training in basic cell biology using *Xenopus laevis* and *Saccharomyces cerevisiae* as model organisms, I decided I wanted to use my research skills in applied science. I took a blind leap into a tiny biotechnology company at which I was employee number four. The lofty goal of this new venture was to directly convert "sludge," a waste product from pulp mills, into fuel-grade ethanol with a one-step fermentation process. The year was 2000, and the political climate was conservative with respect to renewable energy. It was hard to get funding, and it became evident within a few months that I should consider other employment options. As it happened, a biotechnology company was looking for biologists with expertise in cytoskeletal biology. I applied for the position in the antifungal group and was surprised to be offered a position as a cancer cell biologist. Having only worked with yeast and frogs, I was intimidated by the thought of accepting a position requiring expertise in human cancer, but decided it was too good an offer to turn down. I joined as employee number 90 in a rapidly growing company and quickly became the expert they needed. This turned out to be a fantastic opportunity to take my expertise in basic cytoskeletal biology and learn how to apply it to cancer research and drug discovery. After 5 years, we had sent three novel investigational drugs off into the choppy seas of clinical trials and wished them well. At this time, it seemed prudent either to transition into clinical development or to seek new opportunities in drug discovery. The opportunity arose when Genentech started building a cell cycle effort. I was hired into the cell cycle group as employee number 10,000 (approximately) and after 2 years transitioned into a new department focused on the discovery of biomarkers to identify responsive patient populations. Shortly thereafter, Genentech became a member of the larger Roche team. Although I wrote this introduction to provide context for my perspective, it already illustrates some of the realities of working in the biotechnology industry, such as the need to adapt and be open to new opportunities as they arise. In the remainder of the essay, I will highlight some of the major facets of a career in the biotechnology industry that may not be obvious from the outside.

CAUGHT IN THE MATRIX

Nearly all industrial projects are carried out by multidisciplinary teams. I love this aspect of industry, as I enjoy working with experts in other disciplines, projects move forward quickly, and you learn about other fields without having to be an expert. Good team members will be interested in the various other aspects of the project. For example, most chemists will want to learn more about the target biology, a biologist should learn about pharmacology, etc. Obviously, some teams function more smoothly than others, and the way in which different companies manage teams can have a profound influence on one's ability to be productive. Teams can be organized in many different ways. A company could have a matrix organization in which a functional group, such as biochemistry, contributes to all projects through various project leaders, or alternatively, a disease-focused organizational structure where each therapeutic area would have a dedicated group of biochemists. You will hear a lot about organizational structure, but what matters most is whether the teams

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are enabled to move projects forward collaboratively and efficiently. I have been fortunate in this regard overall, but it is something you may want to ask about during an interview. For example, you might ask one of your interviewers: "If you wanted to carry out a project that required help from the mouse group, synthetic chemistry, pharmacology, and structural biology, how would that work?" Pay attention to the length of time and number of acronyms required for the answer and watch closely for expressions of angst or joy.

SAY WHAT?

Jargon is rampant in the biotechnology industry, and it can be quite baffling during an interview and the first few months of a job. Shortly after I started at my second industry job, the project leader told me that a critical goal for the project was to establish a PK/PD relationship. I said I would get right on it and went scurrying back to my computer to try to figure out what a PK/PD relationship was. Eventually, I figured out that it that it meant demonstrating that the molecule of interest gets to the relevant tissue at an efficacious dose and has a biological effect consistent with its mechanism of action. This is something any well-trained biologist would want to demonstrate before promoting a drug candidate; it was the jargon that made it mysterious. Furthermore, there was an expert in pharmacology to handle the PK (pharmacokinetics), while PD (pharmacodynamics) was the responsibility of the biologist, which meant demonstrating on-target mechanism of action in vivo. Do not be intimidated by the jargon; people tend to forget they are using jargon, and it is okay to ask what something means.

YOUR PROJECT WILL BE TERMINATED

This is bound to happen at some point during a scientist's tenure in the biotech industry. Under the best of circumstances, you will be the executioner of your own project. You will go before your senior management and present a series of brilliantly executed experiments that definitively demonstrate that, although the biology is fascinating, for reasons x, y, and z, the project will not be viable. Perhaps the drug will be too toxic or not efficacious or will have insurmountable technical issues. You will have done the company a favor by identifying these issues, and there is honor but little glory in this act. In the worst case, there will be a business decision that has nothing to do with science that dooms your project. In either case, it helps to be adept at identifying or accepting a new project and moving on. Adaptability is key to survival.

A DAY IN THE LIFE

So what does my typical day look like? Early in my career I did a lot of bench work, and I still do some, but currently the largest fraction of my time is spent analyzing, summarizing, and presenting data. I analyze data from my lab, other groups at the company, private databases, public databases, the literature, collaborators, and contract research organizations. I generally interpret data and give presentations to teams to address questions related to drug candidates or drug targets. If key data are needed to answer a question, I get them by either running experiments in my lab, outsourcing, or collaborating. It is generally the most fun when questions need to be addressed in the lab, as I enjoy designing and performing experiments, as well as supervising and mentoring research associates and scientists. However, the stakeholders are generally not concerned about where the data come from, just that they be rigorous and clearly presented in order to enable decision making. I also spend around 25% of my time attending meetings. Sometimes I present, but much of the time I attend to provide feedback and to stay abreast of what other team members and colleagues are doing. Data and progress need to be communicated frequently for teams and departments to function effectively.

In my current role, my primary job is to determine how to identify patients most likely to respond to our investigational drugs and to identify mechanisms of drug resistance. However, there are many different types of positions in biotechnology that require rigorous training in molecular and cell biology. Whether you are hired to identify new drug targets, screen compound libraries, characterize mechanisms of action of drugs, test drug candidates in animal models, or mine data, it is important to understand that when companies hire PhD biologists they are not just looking for a pair of hands. Whoever is hiring needs someone to take intellectual responsibility for a certain area. That job may allow or require a considerable amount of creativity, or it may be largely technical, but the job will generally require someone who can make decisions, exercise scientific judgment, and solve problems with minimal input. How you go about it is context dependent, but you will be an expert for hire working with a team of other experts. Of course, this work is carried out within the context of the larger company goals. The type of job, position within the company, and the corporate culture determine how much influence an individual researcher will have in setting those larger goals. However, even the executives have to answer to a board of directors.

SO, HOW DO I GET A JOB IN INDUSTRY?

Publish good papers in quality journals. Because this is the same thing you need to do to land an academic position, it means you do not have to choose your career path early in your PhD and postdoctoral training. Choose a good lab in a field about which you are passionate and publish something novel. Other things can help you land an industry job, like becoming an expert in a disease-relevant system, such as genetically engineered mouse models, or specializing in immunology. However, I was hired as a cancer cell biologist after completing a postdoctoral fellowship in a yeast lab, so disease specialization is not essential. PhD students are trained to identify scientific questions, carry out experiments to answer those questions, and present the data in a clear manner to other scientists. The hiring managers in industry are looking for those fundamental skills when they set out to hire a scientist, and peer-reviewed publications are the best way to demonstrate that you have what it takes.